Caribou Creek: Land Use Information

Land Use		***Explanation/Comments***
Sub-watershed	Caribou	
Pasture (ac)	**19**	
Forest Land (ac)	**9,154**	
Unstocked Forest (ac)	**1,081**	Includes once burned areas
Highway (ac)		State or County Paved Highways
Double Fires (ac)		Areas which have been burned over twice

Road Data		
Sub-Watershed	Caribou	
1. Forest roads (total miles)	**45**	
CWE road score (av)	35.4	
*Sediment export coefficient (tons/mi/yr)	**16.1**	
#Total Forest Rd Failures (cubic yds delivered)	**981**	*Cumulative Watershed Effects Data*
##2. Unpaved Co.& priv. roads (total miles)	2	
Paved Co.&priv. roads (total miles)	0	
Total C&P Rd Failures (cubic yds delivered)	43.6	*Based on weighted average of forest road failures.*
###Stream bank erosion-both banks (mi)		*<u>**erosion coefficients</u>*
poor condition	**2.72**	*95 tons/yr/mi*
good condition	**ND**	*47.5 tons/yr/mi*

*McGreer et al. 1997
**Stevenson 1999. Good Condition: 5,280' X 2' high bank X 90lbs/ft3 X 0.1 ft/yr X 1ton/2000lbs = 47.5 tons/yr/mi
Poor Condition: 5,280' X 2' high bank X 90lbs/ft3 X 0.2 ft/yr X 1ton/2000lbs = 95 tons/yr/mi
#Total road failures are the amount of sediment observed by the CWE crews that was delivered to the stream. This amount is used to represent the yearly delivery to the stream. This is an over-estimate of sediment delivered to the stream since failures can continue to deliver sediment to the stream for a number of years after they occur, however, in a much reduced quantity. One must also take into consideration that all failures were not observed, which is an under-estimate of delivered sediment. These two factors combined with on-site verification by a

largest failures which probably occurred during the floods of 1996.
##County and private road erosion derived from using the same method as forest roads. Since the method used for foest roads is not designed for non-forest roads, the calculations will be revised if a better method can be found using the existing information.
###Source of data:1995 Beneficial Use R. data.
ND=no data

Caribou Creek: Sediment Yield

Sediment Yield From Land Use		Explanation/Comments	
Watershed:	Caribou	*Acres by Land Use X Sediment Yield Coefficient = Tons Sediment/yr*	
		Yield Coeff. (tons/ac/yr)	
Pasture (tons/yr)	2.6	*0.14*	
Forest Land (tons/yr)	347.9	*0.038*	
Unstocked Forest (tons/yr)	18.4	*0.017*	*(this acreage is a subset of Forest Land acreage)*
Highway (tons/yr)	0	*0.034*	
Double Fires (tons/yr)	0	*0.017*	*(this acreage is a subset of Forest Land acreage)*
Total Yield (tons/yr)	**368.9**	*(Values taken from WATSED and RUSLE models see below explanation [#])*	

*Sediment Yield From Roads		
Watershed:	Caribou	
Forest Roads (tons/yr)	**724.5**	*Miles Forest Rd X Sediment Yield Coeff. from McGreer Model*
Forest Road Failure (tons/yr)	**1403.8**	***Assumes soil density of 1.7 g/cc and a conversion factor of 1.431.*
County and Private Roads (tons/yr)	32.2	
Co. and Private Road Failure (tons/yr)	62.4	

*Percent fines and percent cobble of the Pend Oreille - Treble series B&C soil horizons is 80% fines, 20% cobble (Bonner Co. Soil Survey).
**"Guide for Interpreting Engineering Uses of Soils" USDA, Soil Conservation Service. Nov. 1971.
#Land use sediment yield coefficients sources: Pasture (0.14) obtained from RUSLE with the following inputs: Erosivity based on precipitation; soil erodibility based on soils in the watershed; average slope length and steepness by watershed; plant cover of a 10 yr pasture/hay rotation with intense harvesting and grazing; and no support practices in place to minimize erosion.
Forest Land (0.038) obtained from WATSED with the following inputs: landtype and size of watershed
Unstocked Forest (0.017) obtained from WATSED with the following inputs: Acreage of openings, landtype and years since harvest.
Highways (0.034) obtained from WATSED with the following inputs: Value obtained from the Coeur d'Alene Basin calculations.
Double Fires (0.017) obtained from WATSED with the following inputs: Acreage, years since fire and landtype.

Caribou Creek: Sediment Exported To Stream

	Caribou Creek
Land use export (tons/yr)	368.9
Road export (tons/yr)	756.7
Road failure (tons/yr)	1466.2
Bank export (tons/yr)	
poor condition	258.4
good condition	ND
Total export (tons/yr)	**2850.2**
*Natural Background Mass Failure (tons/yr)	315

*Background mass failure is the difference between the total mass failure observed in the watershed, and the mass failure associated with roads.

Caribou Creek

	Acres	Yield Coefficient (tons/ac/yr)		Background Load (tons/yr)
Total Watershed	9,173			
Presently Forested	9,154			
*Estimated Historically Forested	9,173	0.038		348.6
Estimated Historically Pasture	0	0.14		0
Natural Mass Failure (tons/yr)	315			315
Background Load = Target Load			**Target Load**	**663.4**
			Existing Load	**2850.2**
			Load Reduction	**2186.6**

PACK RIVER WATERSHED

M. CARIBOU CREEK

(tributary to the upper Pack River)

Summary Caribou Creek was placed on the 1996 303(d) water quality impaired list for sediment pollution based upon information provided in the 1995 305(b) report. The 1996 Waterbody Assessment Guidance methodology concluded that Caribou Creek, utilizing the 1995 Beneficial Use Reconnaissance Data, was not fully supporting beneficial uses, but another survey conducted in 1998 concluded that Caribou Creek was fully supportive of all beneficial uses. Since that time, the 1996 Guidance methodology was discounted and no longer considered a valid measure of support status. It was removed from the water quality standards in April 2000. We currently do not have an approved method of determining support status. Since the standards change, additional data from the Cumulative Watershed Effects Analysis was examined and prompted this revision of the Sub-basin Assessment. This recent analysis concluded that Caribou Creek was impaired due to sediment and temperature. A TMDL was developed for Caribou Creek based upon the 1995 Reconnaissance data and the Cumulative Watershed Effects data. Results of sediment modeling indicate that yearly sediment transport to the stream exceeds natural background by four times. Temperature will not be addressed at this time pending an anticipated change to this standard.

1. Physical and Biological Characteristics

Caribou Creek is located in the upper reaches of the Pack River watershed. It comprises 9,173 acres, of that 9,154 acres are managed for timber production. A small number of rural residences exist in the lower drainage. Elevation ranges from 2,155 feet at the confluence with the Pack River up to 6,448 feet at the headwaters on Keokee Mountain. Precipitation ranges from 30-50 inches primarily as snow and spring rain. High volume runoff occurs during spring snowmelt and major rain-on-snow events. Geology of the area is primarily glacial till derived from granitics, alluvial deposits and weakly weathered granite mountain slopes and ridges. Caribou Creek may have historically supported a population of bull trout or been used by bull trout as thermal refuges (Corsi et al.).

2. Pollutant Source Inventory

<u>Point Source Discharges</u>
No point source discharge permits have been issued for Caribou Creek.

<u>Nonpoint Source Discharges</u>
Current management problems that exist in the Caribou watershed are as follows: 1) downcutting of the stream/overflow channel immediately below Mud Springs Reservoir; 2) the road in the southeast quarter of Section 16 which has a Cumulative Watershed Effects road score of 81 (very poor condition); and 3) the road near the center of Section 6 with a road score of 63.

2.a. Summary of Past and Present Pollution Control Efforts

Unknown.

3. Water Quality Concerns and Status

Caribou Creek was listed for sediment in the 1996 303(d) list. This listing was confirmed by the 1998 Cumulative Watershed Effects analysis and the 1995 Beneficial Use Reconnaissance Survey results. In 1998 another Beneficial Use Survey was conducted and its conclusion was full support. Both Surveys utilized the now discounted, 1996 Waterbody Assessment Guidance method to interpret the data. In April 2000, guidance to use the 1996 methodology was removed from the Idaho Water Quality Standards (IDAPA 58.01.02.053). No methodology has replaced the 1996 guidance to date (September 2000). The most recent Cumulative Watershed Effects data indicates that this stream is receiving excessive amounts of sediment and lacks sufficient canopy cover to maintain adequately low stream temperatures.

3.a. Applicable Water Quality Standards

Beneficial uses of Caribou Creek include domestic and agricultural water supply, primary and secondary contact recreation, cold water biota and salmonid spawning. Caribou Creek was listed as impaired for sediment pollution. Idaho's water quality standard for sediment is narrative, and states that, "Sediment shall not exceed quantities ...which impair designated beneficial uses. Temperature standards for salmonid spawning and bull trout also apply.

3.b. Summary and Analysis of Existing Water Quality Data

Results of the 1995 Beneficial Use Reconnaissance survey of Caribou Creek were a macrobiotic invertebrate score of 3.1, a habitat index score of 102 and two age classes of salmonid fish present. Results of the 1998 survey were a macrobiotic invertebrate score of 4.92, a habitat index score of 109 and two age classes of salmonid fish present. The Idaho Department of Lands conducted a Cumulative Watershed Effects analysis in this watershed in 1998. They found adverse conditions existed for canopy cover/stream temperature and sediment. The total sediment delivery score was in the high end of the moderate range, the result of numerous roads in poor condition and numerous mass failures. The report concluded that site specific best management practices must be developed to help restore stream quality. Channel stability index was also moderate, indicating that riparian zones have little plant cover, stream banks are undercut and the streambed lacks large organic debris. Existing small debris in the channel moves during high flows. Complete results of this analysis are found in Appendix B.

3.c. Data Gaps For Determination of Support Status

The lack of an approved assessment process for the determination of support status makes it difficult to determine the support status of this stream. Available data points towards impairment due to sediment and temperature.

Comments received concerning this TMDL expressed concern that clearcuts in this watershed have caused an accelerated runoff affecting water quantity, temperature, peak flows and bedload movement. Flow and habitat are two parameters that Idaho does not recognize as regulated pollutants under the Clean Water Act, even though these elements could prevent complete restoration of beneficial uses. If Idaho's position changes, these two parameters should be examined with respect to attaining full support.

4. Problem Assessment Conclusions

Poorly constructed roads and loss of canopy cover are causing excessive stream sedimentation and increased stream temperature. Pending the outcome of the proposed change to the temperature standard and lack of in-stream temperature data, temperature impairment will be addressed at a later date. A TMDL for sediment is indicated even though we lack a support status determination.

5. TMDL

See attached spreadsheet.

5.a. Numeric Targets

See attached spreadsheet.

5.b. Source Analysis

See attached spreadsheet.

5.c. and 5.e. Monitoring Plan and Linkage Analysis

Because Idaho's Water Quality Standard for sediment is narrative and not based upon something directly measurable in the water column, a different approach is required to achieve a satisfactory monitoring plan. An analysis of the methods available for monitoring the success of TMDLs indicates that, in this case, more than one method should be used to verify the cause of the impairment, track load reduction, and to show that the stream is moving towards full support. The sediment monitoring plan will include three parts:

1. Determination of support status using Beneficial Use Reconnaissance monitoring. If the conclusion of the survey is no impairment for two surveys taken within a five year time period then the stream can be considered restored to full support status.

2. Load reduction measures shall be tracked and quantified. For example, 1.2 miles of road obliteration near a stream, 0.5 miles of stream bank fenced, 5 acres of reforestation, etc.

3. Amount of sediment reduction achieved by implementation of load reduction measures shall be tracked on a yearly basis. For example, 1.2 miles of road obliteration will result in a 6 tons/yr reduction, 0.5 miles of stream bank fenced will result in a 3 ton/yr reduction, 5 acres of reforestation will result in a 0.7

ton/yr reduction, etc.

The reason for this three part approach is the following:

1. DEQ presently uses the Beneficial Use Reconnaissance data to indicate if the stream is biologically impaired. Often times this impairment is based upon only one Reconnaissance survey. The survey should be repeated to insure that the impairment conclusion is correct and repeated twice after implementation to determine if the (improved) support status conclusion is correct. Survey data may show an impairment in fisheries or macroinvertebrates and the cause of the impairment may point to sediment pollution. However, there is not a direct linkage between the pollutant and the impairment. Sediment could be indicated as the problem when, in fact, temperature might be the problem. The Reconnaissance data is not specific as to the cause, just that there is a problem. So using the Reconnaissance data alone to monitor the TMDL is not adequate.

2. There is great uncertainty about how much sediment actually needs to be reduced before beneficial uses are restored. These TMDLs use a very conservative approach, in that the sediment target is limited to natural background amounts. However, beneficial uses may be fully supported at some point before this target is achieved. Therefore, a measure of sediment reduction cannot be used exclusively to determine a return to full support.

3. Because TMDLs are based upon target loads measured in a mass per unit time there must be a method included to directly measure load reductions. Coefficients which estimate sedimentation rates over time based upon land use have been used to develop the existing loads. This same method can be used for land where erosion has been reduced. Road erosion rates are based upon the Cumulative Watershed Effects road scores. These scores can be updated as road improvements are made and the corresponding load reduction calculated.

5.d. Allocations

Load allocations are based upon land use as shown in the attached spreadsheet. Roads and stream banks are often the source of excess sediment.

5.f. Margin of Safety

Because the measure of sediment entering a stream throughout the entire watershed is a difficult and inexact science, assigning an arbitrary margin of safety would just add more error to the analysis. Instead, all assumptions made in the model have been the most conservative available. In this way, a margin of error was built into each step of the analysis. For an explanation of how the Cumulative Watershed Effects data was collected and processed, refer to the Idaho Department of Lands manual titled, "Forest Practices Cumulative Watershed Effects Process For Idaho". One important detail to note when looking at how the Cumulative Effects data was used in the TMDL is that, although all forest roads in the watershed were not assessed, the field crews are directed to assess the roads most likely to be contributing sediment to the stream. This weighted the average road scores towards the ones most likely to be in poor condition.

References

Corsi, C., DuPont J., Mosier, D., Peters, R., Roper, B. 1998. Lake Pend Oreille Key Watershed Bull Trout Problem Assessment . Idaho Department of Health and Welfare, Division of Environmental Quality. Coeur d'Alene, Idaho.

Dechert, T., Raiha, D. And Saunders, V. 1999. Caribou Creek Cumulative Watershed Effects Assessment. September. Idaho Department of Lands. Coeur d'Alene, Idaho.

N. **GROUSE CREEK**

(tributary to the middle Pack River)

Summary: Grouse Creek was placed on the 1996 303(d) water quality impaired list due to sediment pollution. The 1996 Waterbody Assessment Guidance methodology using the 1994 Beneficial Use Reconnaissance data concluded that Grouse Creek was fully supportive of all beneficial uses. Grouse Creek was delisted based upon this finding in the 1998 303(d) list. The 1996 methodology was later discounted, and in April 2000, removed from the water quality standards. We currently do not have an approved method of determining support status. Since the standards change, new bank stability data has been collected and analyzed. Using the bank stability data and U.S. Forest Service data, it was determined that Grouse Creek mainstem was impaired due to sediment. Yearly sediment transport to the stream exceeds natural background by two and one half times.

1. Physical and Biological Characteristics

[The following information was summarized from the Grouse Creek Environmental Assessment, USFS, 1993.]

The Grouse Creek drainage is a 31,352 acre (127 km^2), third order watershed. The North Fork of Grouse Creek (9,016 acres, 36 km^2), Wylie Creek (1,966 acres, 8 km^2), Upper Grouse Creek (9,366 acres, 38 km^2) and the South Fork of Grouse Creek (4,386 acres, 18 km^2) are the major sub-drainages of Grouse Creek (Figure 1). The mainstem of Grouse Creek is 84% National Forest lands and the remaining area is in private ownership.

Elevations range from 6,600 feet (1992 m) at Mount Willard to approximately 2,300 feet (700 m) at the lower end of the drainage. Annual precipitation averages from 53 inches (135 cm) at the upper elevations to 35 inches (89 cm) near the mouth. The area has a high frequency of rain-on-snow flood events between 2,500 feet (762 m) and 4,500 feet (1372 m) elevation.

Glaciers deposited two types of materials, glacial till and outwash, on top of the underlying bedrock. Outwash is sorted and stratified sand and gravel laid down in valley bottoms by flowing water from the melting ice. Till is deposits made directly by the glacier when it melts. Most of the area is covered with glacial till with deeper layers often compacted by the weight of the ice and impermeable. The till closest to the surface was usually deposited as the glacier retreated and is commonly loose and permeable. Water frequently collects at the point of contact between these two layers.

Most of the soils in the area are formed of two different parent material types. The lower subsoil and substratum are formed from glacial till and have a sandy loam texture, moderate amounts of rock fragments, and poor water and nutrient holding capacity. Surface soils on the other hand are formed from volcanic ash with few rock fragments and high water and nutrient holding capacity.

The land use history of the Grouse Creek drainage is very similar to that of other drainages in the Pend Oreille area. Homesteading began in the late 1800's with early light timber harvesting occurring along the valley bottom from 1900 to about 1920. The very large western red cedars and white pines were easily accessible and the most sought after. Some primitive roads were constructed in valley bottoms. After 1920, timber harvest activity began to intensify. Between 1920 and 1930 the Humbird Lumber Company constructed a logging railroad along Grouse Creek with associated spur lines, loading areas, camps, logging chutes, flumes, and a pole road. By 1934 roughly 70% of the main Grouse Creek drainage had been cleared and/or burned. Logging was concentrated in the stream bottoms and proximal side slopes. The unharvested 30% of the drainage included higher elevations and ridge tops dominated by alpine fir which was smaller in size than the valley timber.

Stream changes occurred as a result of this activity. Large amounts of bedload sediment moved from Plank, Wylie, Flume and other headwater channels into the main Grouse Creek channel. As valley channels filled with bedload, the stream greatly accelerated its natural movement back and forth across the valley floor. The result is a river channel that today is much wider and shallower than expected. As bedload inputs from the headwaters diminish and large riparian trees are re-established Grouse Creek will regain its equilibrium and become a more naturally functioning channel. Today forestry is currently practiced on about 99% of the Grouse Creek watershed above the Wylie Creek confluence.

Grouse Creek contains important fishery resources. Gerrard rainbow trout utilize Grouse Creek heavily in the spring for spawning and rearing. Bull trout also move into the drainage in late spring and spawn in the fall. Grouse Creek provides habitat for both resident westslope cutthroat trout and cutthroat that move in and out of the drainage from the lake. Idaho Fish and Game data shows that bull trout redds in Grouse Creek have gradually declined from 1983 through 1995.

2. Pollutant Source Inventory

<u>Point Source Discharges</u>
There are no permitted point source discharges in Grouse Creek.

<u>Nonpoint Source Discharges</u>
The USFS's 1993 environmental assessment of Grouse Creek concluded that the mainstem of Grouse Creek may take a couple hundred years to regain equilibrium from its current state due to excess bedload (USDA 1993). Causes of excess bedload were activities associated with logging from the 1930's to the present.

2.a. Summary of Past and Present Pollution Control Efforts

In 1994 the USFS placed 62 structures in Grouse Creek, 26 of these were single wing deflectors, 22 point bars and 57 cover logs. Some of the single wall deflector sites had erosion control matting installed and seeded to stabilize loose soils. In 1995, the USFS placed 50 structures in Grouse Creek, 32 of these were single wing deflectors, three "V" notched, one drop log, three point bars and one root wad pool cover. In 1997, work continued with the removal of 20 boulder clusters and an unrecorded number of single wall deflectors, point bars, and lateral habitat cover logs. In 1999, the Hemlock Trail trailhead was relocated and decommissioned approximately 5,000 feet of Grouse Creek Road. This work included the removal of 11 culverts, re-contouring and revegetation. Willows were planted at stream crossings.

3. Water Quality Concerns and Status

The lower channel of Grouse Creek currently carries large amounts of bedload which has caused braided channels, bank erosion and a rapidly shifting channel. In 1996 Grouse Creek was determined to be water quality impaired due to sediment pollution and placed on the 1996 list of impaired waters.

3.a. Applicable Water Quality Standards

Idaho's water quality standard for sediment is narrative and states that; "Sediment shall not exceed quantities...which impair designated beneficial uses. Grouse Creek does not have designated uses and therefore, existing uses will be protected. Existing uses include agricultural and domestic water supply (USDA, 1993), cold water biota, salmonid spawning, and primary and secondary contact recreation (mean monthly peak flow of 246 cfs).

3.b. Summary and Analysis of Existing Water Quality Data

Conclusions of the 1993 U.S. Forest Service's environmental assessment of this watershed were that the lower reach of Grouse Creek was not a naturally functioning stream channel due to excessive amounts of bedload. The DEQ assessed the support status of the stream using data collected in 1994 from the Beneficial Use Reconnaissance Project. The conclusion of this assessment, utilizing the process outlined in the 1996 Waterbody Assessment Guidance, was that Grouse Creek fully supported all its beneficial uses. However, use of the 1996 Guidance process has been determined to be inadequate for the determination of support status. Scores for the various parameters measured were a macroinvertebrate biotic index score of 3.99 and a habitat index score of 79. Three age classes of salmonid fish were present during the survey. Results of the 1998 Cumulative Watershed Effects analysis concluded that the forestry portion (upper mainstem of Grouse Creek) of the watershed was rated overall low for sediment delivery to the stream. They did not evaluate the lower mostly privately owned, non-forested portion of the watershed. In August 2000, the DEQ evaluated bank stability in the mainstem of Grouse Creek. Data from that work has not yet been analyzed, however, the field crew reported extensive bank erosion downstream of National Forest land.

3.c. Data Gaps

As of September 2000, DEQ does not yet have an EPA approved methodology for assessing beneficial use support status. This data gap is not critical in this case since other data exists that was sufficient for this determination.

Comments received concerning this TMDL expressed concern that clearcuts in this watershed have caused an accelerated runoff affecting water quantity, temperature, peak flows and bedload movement. Flow and habitat are two parameters that Idaho does not recognize as regulated pollutants under the Clean Water Act, even though these elements could prevent complete restoration of beneficial uses. If Idaho's position changes, these two parameters should be examined with respect to attaining full support.

4. Problem Assessment Conclusions

Past forest practices have caused large quantities of bedload (sediment) to move down the Grouse Creek mainstem. Bedload continues to be transported to the mainstem from the North Fork sub-watershed (see North Fork Grouse Creek problem assessment). The forested portions of the mainstem above Wylie Creek are affected by this bedload but maintains beneficial uses. However, the lower gradient section of the creek where bedload settles out is in poor condition and requires a sediment TMDL to aid in its recovery.

5. TMDL

Problem Statement: Excess sediment is impairing the beneficial uses of cold water biota and salmonid spawning in the mainstem of Grouse Creek.

5.a. Numeric Targets

See attached spreadsheet.

5.b. Source Analysis

See attached spreadsheet.

5.d. Allocations

See attached spreadsheet.

5.c. and 5.e. Monitoring Plan and Linkage Analysis

Because Idaho's Water Quality Standard for sediment is narrative and not based upon something directly measurable in the water column, a different approach is required to achieve a satisfactory monitoring plan. An analysis of the methods available for monitoring the success of TMDLs indicates that, in this case, more than one method should be used to verify the cause of the impairment, track load reduction, and to show that the stream is moving towards full support. The sediment monitoring plan will include three parts:

1. Determination of support status using Beneficial Use Reconnaissance monitoring. If the conclusion of the survey is no impairment for two surveys taken within a five year time period then the stream can be considered restored to full support status.

2. Load reduction measures shall be tracked and quantified. For example, 1.2 miles of road obliteration near a stream, 0.5 miles of stream bank fenced, 5 acres of reforestation, etc.

3. Amount of sediment reduction achieved by implementation of load reduction measures shall be tracked on a yearly basis. For example, 1.2 miles of road obliteration will result in a 6 tons/yr reduction, 0.5 miles of stream bank fenced will result in a 3 ton/yr reduction, 5 acres of reforestation will result in a 0.7

ton/yr reduction, etc.

The reason for this three part approach is the following:

1. DEQ presently uses the Beneficial Use Reconnaissance data to indicate if the stream is biologically impaired. Often times this impairment is based upon only one Reconnaissance survey. The survey should be repeated to insure that the impairment conclusion is correct and repeated twice after implementation to determine if the (improved) support status conclusion is correct. Survey data may show an impairment in fisheries or macroinvertebrates and the cause of the impairment may point to sediment pollution. However, there is not a direct linkage between the pollutant and the impairment. Sediment could be indicated as the problem when, in fact, temperature might be the problem. The Reconnaissance data is not specific as to the cause, just that there is a problem. So using the Reconnaissance data alone to monitor the TMDL is not adequate.

2. There is great uncertainty about how much sediment actually needs to be reduced before beneficial uses are restored. These TMDLs use a very conservative approach, in that the sediment target is limited to natural background amounts. However, beneficial uses may be fully supported at some point before this target is achieved. Therefore, a measure of sediment reduction cannot be used exclusively to determine a return to full support.

3. Because TMDLs are based upon target loads measured in a mass per unit time there must be a method included to directly measure load reductions. Coefficients which estimate sedimentation rates over time based upon land use have been used to develop the existing loads. This same method can be used for land where erosion has been reduced. Road erosion rates are based upon the Cumulative Watershed Effects road scores. These scores can be updated as road improvements are made and the corresponding load reduction calculated.

5.f. Margin of Safety

Because the measure of sediment entering a stream throughout the entire watershed is a difficult and inexact science, assigning an arbitrary margin of safety would just add more error to the analysis. Instead, all assumptions made in the model have been the most conservative available. In this way, a margin of error was built into each step of the analysis. For an explanation of how the Cumulative Watershed Effects data was collected and processed, refer to the Idaho Department of Lands manual titled, "Forest Practices Cumulative Watershed Effects Process For Idaho". One important detail to note when looking at how the Cumulative Effects data was used in the TMDL is that, although all forest roads in the watershed were not assessed, the field crews are directed to assess the roads most likely to be contributing sediment to the stream. This weighted the average road scores towards the ones most likely to be in poor condition.

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Grouse Creek Mainstem: Land Use Information

Land Use		***Explanation/Comments***
Sub-watershed	Grouse mainstem	
Pasture (ac)	**7,078**	
Forest Land (ac)	**16,848**	
Unstocked Forest (ac)	**1,192**	Includes once burned areas
Highway (ac)	1	State or County Paved Highways
Double Fires (ac)	268	Areas which have been burned over twice
Road Data		
Sub-Watershed	Grouse mainstem	
1. Forest roads (total miles)	**42**	
CWE road score (av)	20.9	
*Sediment export coefficient (tons/mi/yr)	**5.1**	
#Total Forest Rd Failures (cubic yds delivered)	**57**	*Cumulative Watershed Effects Data*
##2. Unpaved Co.& priv. roads (total miles)	50.3	
Paved Co.&priv. roads (total miles)	3	
Total C&P Rd Failures (cubic yds delivered)	68.3	*Based on weighted average of forest road failures.*
###Stream bank erosion-both banks (mi)		***erosion coefficients*
poor condition	**1.7**	*95 tons/yr/mi*
good condition	**0.5**	*47.5 tons/yr/mi*

*McGreer et al. 1997
**Stevenson 1999. Good Condition: 5,280' X 2' high bank X 90lbs/ft3 X 0.1 ft/yr X 1ton/2000lbs = 47.5 tons/yr/mi
Poor Condition: 5,280' X 2' high bank X 90lbs/ft3 X 0.2 ft/yr X 1ton/2000lbs = 95 tons/yr/mi
#Total road failures are the amount of sediment observed by the CWE crews that was delivered to the stream. This amount is used to represent the yearly delivery to the stream. This is an over-estimate of sediment delivered to the stream since failures can continue to deliver sediment to the stream for a number of years after they occur, however, in a much reduced quantity. One must also take into consideration that all failures were not observed, which is an under-estimate of delivered sediment. These two factors combined with on-site verification by a

largest failures which probably occurred during the floods of 1996.
##County and private road erosion derived from using the same method as forest roads. Since the method used for foest roads is not designed for non-forest roads, the calculations will be revised if a better method can be found using the existing information.
###Source of data from DEQ 2000 bank inventory survey.

Grouse Creek Mainstem: Sediment Yield

Sediment Yield From Land Use		Explanation/Comments
Watershed:	Grouse mainstem	*Acres by Land Use X Sediment Yield Coefficient = Tons Sediment/yr* *Yield Coeff. (tons/ac/yr)*
Pasture (tons/yr)	990.9	*0.14*
Forest Land (tons/yr)	640.0	*0.038*
Unstocked Forest (tons/yr)	20.1	*0.017 (this acreage is a subset of Forest Land acreage)*
Highway (tons/yr)	0	*0.034*
Double Fires (tons/yr)	4.6	*0.017 (this acreage is a subset of Forest Land acreage)*
Total Yield (tons/yr)	**1655.6**	*(Values taken from WATSED and RUSLE models see below explanation [#])*

*Sediment Yield From Roads		
Watershed:	Grouse mainstem	
Forest Roads (tons/yr)	**214.2**	*Miles Forest Rd X Sediment Yield Coeff. from McGreer Model*
Forest Road Failure (tons/yr)	**81.6**	***Assumes soil density of 1.7 g/cc and a conversion factor of 1.431.*
County and Private Roads (tons/yr)	256.5	
Co. and Private Road Failure (tons/yr)	97.7	

*Percent fines and percent cobble of the Pend Oreille - Treble series B&C soil horizons is 80% fines, 20% cobble (Bonner Co. Soil Survey).
**"Guide for Interpreting Engineering Uses of Soils" USDA, Soil Conservation Service. Nov. 1971.
#Land use sediment yield coefficients sources: Pasture (0.14) obtained from RUSLE with the following inputs: Erosivity based on precipitation; soil erodibility based on soils in the watershed; average slope length and steepness by watershed; plant cover of a 10 yr pasture/hay rotation with intense harvesting and grazing; and no support practices in place to minimize erosion.
Forest Land (0.038) obtained from WATSED with the following inputs: landtype and size of watershed
Unstocked Forest (0.017) obtained from WATSED with the following inputs: Acreage of openings, landtype and years since harvest.
Highways (0.034) obtained from WATSED with the following inputs: Value obtained from the Coeur d'Alene Basin calculations.
Double Fires (0.017) obtained from WATSED with the following inputs: Acreage, years since fire and landtype.

Grouse Creek Mainstem: Sediment Exported To Stream

	Grouse Creek mainstem
Land use export (tons/yr)	1655.6
Road export (tons/yr)	470.7
Road failure (tons/yr)	179.3
Bank export (tons/yr)	
poor condition	161.5
good condition	23.8
Total export (tons/yr)	**2490.9**
*Natural Background Mass Failure (tons/yr)	25.8

*Background mass failure is the difference between the total mass failure observed in the watershed, and the mass failure associated with roads.

Grouse Creek Mainstem

	Acres	Yield Coefficient (tons/ac/yr)		Background Load (tons/yr)
Total Watershed	23,926			
Presently Forested	16,848			
*Estimated Historically Forested	23,926	0.038		909.2
Estimated Historically Pasture	0	0.14		0
Natural Mass Failure (tons/yr)				25.8
Background Load = Target Load			**Target Load**	**935**
			Existing Load	**2490.9**
			Load Reduction	**1555.9**

*Based upon interview with Stanley Jacobsen (USFS, 1992).